

SECTION 1605 LOAD COMBINATIONS

1605.1 General. Buildings and other structures and portions thereof shall be designed to resist:

1. The load combinations specified in Section 1605.2, 1605.3.1 or 1605.3.2,
2. The load combinations specified in Chapters 18 through 23, and
3. The load combinations with overstrength factor specified in Section 12.4.3.2 of ASCE 7 where required by Section 12.2.5.2, 12.3.3.3 or 12.10.2.1 of ASCE 7. With the simplified procedure of ASCE 7 Section 12.14, the load combinations with overstrength factor of Section 12.14.3.2 or ASCE 7 shall be used.

Applicable loads shall be considered, including both earthquake and wind, in accordance with the specified load combinations. Each load combination shall also be investigated with one or more of the variable loads set to zero.

Where the load combinations with overstrength factor in Section 12.4.3.2 of ASCE 7 apply, they shall be used as follows:

1. The basic combinations for strength design with overstrength factor in lieu of Equations 16-5 and 16-7 in Section 1605.2.1.
2. The basic combinations for *allowable stress design* with overstrength factor in lieu of Equations 16-12, 16-13 and 16-15 in Section 1605.3.1.
3. The basic combinations for *allowable stress design* with overstrength factor in lieu of Equations 16-20 and 16-21 in Section 1605.3.2.

1605.1.1 Stability. Regardless of which load combinations are used to design for strength, where overall structure stability (such as stability against overturning, sliding, or buoyancy) is being verified, use of the load combinations specified in Section 1605.2 or 1605.3 shall be permitted. Where the load combinations specified in Section 1605.2 are used, strength reduction factors applicable to soil resistance shall be provided by a *registered design professional*. The stability of retaining walls shall be verified in accordance with Section 1807.2.3.

1605.2 Load combinations using strength design or load and resistance factor design.

1605.2.1 Basic load combinations. Where strength design or *load and resistance factor design* is used, structures and portions thereof shall resist the most critical effects from the following combinations of factored loads:

$$1.4(D + F) \quad (\text{Equation 16-1})$$

$$1.2(D + F + T) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R) \quad (\text{Equation 16-2})$$

$$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (f_1 L \text{ or } 0.8 W) \quad (\text{Equation 16-3})$$

$$1.2D + 1.6W + f_1 L + 0.5(L_r \text{ or } S \text{ or } R) \quad (\text{Equation 16-4})$$

$$1.2D + 1.0E + f_1 L + f_2 S \quad (\text{Equation 16-5})$$

$$0.9D + 1.6W + 1.6H \quad (\text{Equation 16-6})$$

$$0.9D + 1.0E + 1.6H \quad (\text{Equation 16-7})$$

where:

f_1 = 1 for floors in places of public assembly, for live loads in excess of 100 pounds per square foot (4.79 kN/m²), and for parking garage live load, and
= 0.5 for other live loads.

f_2 = 0.7 for roof configurations (such as saw tooth) that do not shed snow off the structure, and
= 0.2 for other roof configurations.

Exception: Where other factored load combinations are specifically required by the provisions of this code, such combinations shall take precedence.

1605.2.2 Flood loads. Where flood loads, F_a , are to be considered in the design, the load combinations of Section 2.3.3 of ASCE 7 shall be used.

1605.3 Load combinations using allowable stress design.

1605.3.1 Basic load combinations. Where *allowable stress design* (working stress design), as permitted by this code, is used, structures and portions thereof shall resist the most critical effects resulting from the following combinations of loads:

$$D + F \quad (\text{Equation 16-8})$$

$$D + H + F + L + T \quad (\text{Equation 16-9})$$

$$D + H + F + (L_r \text{ or } S \text{ or } R) \quad (\text{Equation 16-10})$$

$$D + H + F + 0.75(L + T) + 0.75(L_r \text{ or } S \text{ or } R) \quad (\text{Equation 16-11})$$

$$D + H + F + (W \text{ or } 0.7E) \quad (\text{Equation 16-12})$$

$$D + H + F + 0.75(W \text{ or } 0.7E) + 0.75L + 0.75(L_r \text{ or } S \text{ or } R) \quad (\text{Equation 16-13})$$

$$0.6D + W + H \quad (\text{Equation 16-14})$$

$$0.6D + 0.7E + H \quad (\text{Equation 16-15})$$

Exceptions:

1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow loads of 30 psf (1.44 kN/m²) or less and roof live loads of 30 psf or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 psf (1.44 kN/m²), 20 percent shall be combined with seismic loads.

1605.3.1.1 Stress increases. Increases in allowable stresses specified in the appropriate material chapter or the referenced standards shall not be used with the load combinations of Section 1605.3.1, except that increases shall be permitted in accordance with Chapter 23.

1605.3.1.2 Flood loads. Where flood loads, F_a , are to be considered in design, the load combinations of Section 2.4.2 of ASCE 7 shall be used.

In the case of material, the mechanical properties of which do not conform to the requirements of one of the listed specifications, the test specimens and procedures shall conform to the applicable requirements of ASTM A370, and the specimens shall exhibit a yield strength equal to or exceeding the design yield strength and an elongation of not less than (a) 20 percent in 2 inches (51 millimeters) for sheet and strip, or (b) 18 percent in 8 inches (203 millimeters) for plates, shapes and bars with adjustments for thickness for plates, shapes and bars as prescribed in ASTM A36/A36M, A242/A242M, A529/A529M, A572/A572M, A588/A588M, whichever specification is applicable on the basis of design yield strength.

The number of tests shall be as prescribed in ASTM A6/A6M for plates, shapes, and bars; and ASTM A606, A1008/A1008M and A1011/A1011M for sheet and strip.

If as-formed strength is utilized, the test reports shall show the results of tests performed on full section specimens in accordance with the provisions of the AISI North American Specifications for the Design of Cold-Formed Steel Structural Members. They shall also indicate compliance with these provisions and with the following additional requirements:

- a) The yield strength calculated from the test data shall equal or exceed the design yield strength.
- b) Where tension tests are made for acceptance and control purposes, the tensile strength shall be at least 6 percent greater than the yield strength of the section.
- c) Where compression tests are used for acceptance and control purposes, the specimen shall withstand a gross shortening of 2 percent of its original length without cracking. The length of the specimen shall be not greater than 20 times the least radius of gyration.
- d) If any test specimen fails to pass the requirements of the subparagraphs (a), (b), or (c) above, as applicable, two retests shall be made of specimens from the same lot. Failure of one of the retest specimens to meet such requirements shall be the cause for rejection of the lot represented by the specimens.

3.3 PAINT

The standard shop paint is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional coating.

When specified, the standard shop paint shall conform to one of the following:

- a) Steel Structures Painting Council Specification, SSPC No. 15.
- b) Or, shall be a shop paint which meets the minimum performance requirements of the above listed specification.

SECTION 4.

DESIGN AND MANUFACTURE

4.1 METHOD

Joists shall be designed in accordance with these specifications as simply supported, uniformly loaded trusses supporting a floor or roof deck so constructed as to brace the top chord of the joists against lateral buckling. Where any applicable design feature is not specifically covered herein, the design shall be in accordance with the following specifications:

- a) Where the steel used consists of hot-rolled shapes, bars or plates, use the American Institute of Steel Construction, *Specification for Structural Steel Buildings*.
- b) For members that are cold-formed from sheet or strip steel, use the American Iron and Steel Institute, *North American Specification for the Design of Cold-Formed Steel Structural Members*.

Design Basis:

Designs shall be made according to the provisions in this Specification for either Load and Resistance Factor Design (LRFD) or for Allowable Strength Design (ASD).

Load Combinations:

LRFD:

When load combinations are not specified to the joist manufacturer, the required stress shall be computed for the factored loads based on the factors and load combinations as follows:

$$1.4D$$

$$1.2D + 1.6 (L, \text{ or } L_r, \text{ or } S, \text{ or } R)$$

ASD:

When load combinations are not specified to the joist manufacturer, the required stress shall be computed based on the load combinations as follows:

$$D$$

$$D + (L, \text{ or } L_r, \text{ or } S, \text{ or } R)$$

Where:

D = dead load due to the weight of the structural elements and the permanent features of the structure

L = live load due to occupancy and movable equipment

L_r = roof live load

S = snow load

R = load due to initial rainwater or ice exclusive of the ponding contribution

When special loads are specified and the specifying professional does not provide the load combinations, the provisions of ASCE 7, "Minimum Design Loads for Buildings and Other Structures" shall be used for LRFD and ASD load combinations.

